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COMPLETE SPECIFICATION

Production of Granular Fertilisers

We, CHEMISCHE WERKE MUNCHEN OTTO BARLOCHER G.M.B.H., a German Company, of 16 Reisstrasse, 8 Munich 54, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to fertilisers, and an object of the invention is to provide an improvide fertiliser composition which is able to develop its fertilising activity in stages extending over a prolonged period of time.

According to this invention there is provided a granular fertiliser composition capable of fertilising activity over a predetermined prolonged period of time, consisting of a mixture of granular fertiliser components the granules of which consist of a coherent mass of particles of a pulverulent fertiliser bound together and coated with one or more solid organic compounds having a melting point between 40°C and 150°C, the respective components having different organic compounds so selected for different lyophilic (hydrophobic) and hydrophilic properties as to impart to the respective components different rates of dissolution in the soil whereby the composition has a controlled rate of dissolution in stages extending over the period predetermined.

Also according to this invention there is provided a process for the production of a granular fertiliser composition capable of developing its fertilising activity over a predetermined extended period of time, which comprises separately preparing a plurality of granular fertiliser components of the composition from a pulverulent fertiliser with the aid of organic compounds as granulating agents which have a melting point between 40°C and 150°C and which comprise compounds having predominantly hydrophilic properties, compounds having substantially balanced hydrophilic and hydrophobic properties, and compounds having pronounced hydrophobic properties, one or more of the compounds having similar lyophilic or hydrophilic properties being utilised as the granulating agent for preparation of an individual component and different granulating agents being utilised for the respective components, the different granulating agents being selected for differing lyophilic and hydrophilic properties such as to impart to the components different times of dissolution in the earth in stages embracing the required predetermined extended period of activity, each component being prepared by mixing the pulverulent fertiliser with the respective granulating agent, heating the mixture to melt the granulating agent while vigorously stirring the mixture, and then cooling the resultant hot mix to room temperature while under reduced stirring to form granules consisting of particles of the fertiliser coated and bound with the granulating agent; and mixing the separately prepared components to form the composition.

Fertilisers on which compositions according to this invention may be based include particularly urea and calcium cyanamide, and also ammonium nitrate, calcium nitrate or sodium nitrate, Thomas meal, or mixed fertilisers. Since the particles of fertiliser contained in the granules are coated with the organic compounds employed as granulating agents in the process, their dissolution in the soil by the action of moisture depends to a great extent on the ratio of the hydrophobic (lyophilic) properties to the hydrophilic properties of the granulating agents employed.

Fertilisers which are granulated with granulating agents having pronounced hydrophilic properties dissolve rapidly, that is to say in the course of a few days after applica-

tion. Strongly hydrophilic granulating agents include fatty alcohol polyglycol ethers, alkylphenol polyglycol ethers, fatty acid alkylolamides, and fatty alkylolamine esters.

Granulating agents in which lyophilic and hydrophilic properties are approximately in balance are partial esters derived from fatty acids and polyhydric alcohols have a plurality of free hydroxyl groups, for example glycerol monostearate, glycerol monoricinoleate, trimethylolpropylmonocaprinate, pentaerythritemonocaprilate, anhydrosorbite monolaurate, or short-chain fatty alcohols such as hexanol. With those granulating agents which already exhibit distinctly lyophilic properties, the dissolution time of the fertiliser is longer and may extend over a period of months depending on the ratio of the lyophilic to the hydrophilic groups in the molecule of the granulating agent. If granulation is effected with predominantly lyophilic granulating agents, such as partial esters having only one free hydroxyl group and long-chain fatty acid radicals, for example pentaerythrite tristearate or glycerol di/tristearate, or with fatty alcohols of medium chain length, such as octyl alcohol, or oxy fatty acids such as ricinoleic acid or 12-oxy-stearic acid, the hydrophobic effect of the granulating agents is already so strong that dissolution of the fertiliser extends to from one to two years.

Markedly lyophilic or hydrophobic granulating agents are esters derived from long-chain fatty alcohols or synthetic alcohols and long-chain fatty acids, for example spermaceti or stearyl stearate. Long-chain fatty alcohols, for example stearyl alcohol, or long-chain fatty acids, for example stearic acid or arachic acid, are also granulating agents having a marked hydrophobic effect. This group of granulating agents also includes paraffin wax and synthetic paraffin wax (and also in mixture with mineral oils), amides of long-chain fatty acids, for example stearic acid amide, or long-chain ethers such as distearyl ether. Granular fertilisers produced with such granulating agents having a marked water-repelling action dissolve very slowly and develop their activity as fertilisers only after a period of between 2 and 5 years.

Those skilled in the art will readily appreciate the possibilities of selection of combinations of granulating agents from the different groups mentioned, thereby to obtain any desired further degrees of adjustment of the lyophilic/hydrophilic properties to suit their requirements as to dissolution times for the fertiliser components in any particular case.

The dissolution time for a fertiliser component depends not only on the kind of granulating agent, but also on the quantity thereof employed. For a given lyophilic granulating agent, the greater the quantity used for the granulation, the longer will be the time required for dissolution of the granular fertiliser produced. For example, for the production of a granular fertiliser based on calcium cyanamide, which is to develop its fertilising action fully only about 3 years after its application, it is advantageous to perform the granulation process with a relatively large amount of 20% of stearyl stearate as granulating agent.

An advantage of fertiliser compositions according to the invention is that, owing to their staged dissolution times, it is not necessary to apply fertiliser separately once or twice every year.

Another advantage is that the organic compounds employed as granulating agents in the process and incorporated in the granules of the composition act also as anti-caking agents for preventing caking of the composition during storage.

The preparation of each granular fertiliser component of the composition may be performed in the following manner. The pulverulent fertiliser to be granulated is introduced, together with the granulating agent, into a high-speed mixer provided with heating and cooling facilities. The mixing mechanism is rotated at more than 1000 rpm for thoroughly mixing the constituents, and the mix is raised to a temperature above the melting point of the granulating agent. In the case of granulating agents having low melting points, for example tallow fatty alcohol having a melting point of about 48°C, this temperature is reached by frictional heat in the high-speed mixer, without need for heat to be applied. In the case of granulating agents having higher melting points, for example hardened castor oil having a melting point of 84°C, additional heating is applied. After the melting point of the granulating agent is exceeded, so that the granulating agent is molten, the speed of rotation of the stirring mechanism is reduced to below 700 rpm, and if additional heating was previously applied, its supply is discontinued. The mix is cooled while the slow stirring is continued, until granules form. Depending on the speed of stirring, the temperature, and the granulating agent, smaller or larger granules having diameters of between 0.1 and 10 mm may be obtained. The preferred granulation temperatures are between 45 and 55°C.

The following Example illustrates the invention.

Example

A urea fertiliser composition which develops its action after various staged periods of time is produced as follows.

(a) A granular urea fertiliser component is prepared from 200 kg of urea which are granulated with 25kg of hardened tallow fatty alcohol coated with 10% ethylene oxide, as granulating agent, by stirring the two con-

stituents at 1800 rpm in a mixer provided with heating and cooling facilities. The granulation temperature of about 60°C is attained by means of slight applied heating, subsequently removed. Stirring is then continued at 600 rpm and additional cooling is applied. Granules having a mean diameter of 1 mm are obtained.

In a manner similar to that described in (a), granular fertiliser components are prepared from:

(b) 200 kg of urea granulated with 20 kg of glycerol monostearate;

(c) 200 kg of urea granulated with 15 kg of pentaerythrite tristearate;

(d) 200 kg of urea granulated with 20 kg of cetyl palmitate; and

(e) 200 kg of urea granulated with 30 kg of stearyl stearate.

These give preparations are then mixed to form a granular fertiliser composition containing 1000 kg of urea, which will dissolve and thus become active in the soil at the rate of 20% in the following stages:

(i) immediately,
(ii) after about 6 months,
(iii) after about one year,
(iv) after about two years,
(v) after three to four years.

A fertiliser composition of this nature is very suitable, for example, for fertilising large wooded areas from aircraft.

WHAT WE CLAIM IS:—

1. A granular fertiliser composition capable of fertilising activity over a predetermined prolonged period of time, consisting of a mixture of granular fertiliser components the granules of which consist of a coherent mass of particles of a pulverulent fertiliser bound together and coated with one or more solid organic compounds having a melting point between 40°C and 150°C, the respective components having different organic compounds so selected for different lyophilic (hydrophobic) and hydrophilic properties as to impart to the respective components different rates of dissolution in the soil whereby the composition has a controlled rate of dissolution in stages extending over the period predetermined.

2. A granular fertiliser composition as defined in claim 1 the fertiliser particles of which consist of urea.

3. A granular fertiliser composition as defined in claim 1 the fertiliser particles of which consist of calcium cyanamide.

4. A granular fertiliser composition as defined in claim 1 substantially as described in the foregoing Example.

5. A process for the production of a granular fertiliser composition capable of developing its fertilising activity over a predetermined extended period of time, which comprises separately preparing a plurality of granular fertiliser components of the composition from a pulverulent fertiliser with the aid of organic compounds as granulating agents which have a melting point between 40°C and 150°C and which comprise compounds having predominantly hydrophilic properties, compounds having substantially balanced hydrophilic and hydrophobic properties, and compounds having pronounced hydrophobic properties, one or more of the compounds having similar lyophilic or hydrophilic properties being utilised as the granulating agent for preparation of an individual component and different granulating agents being utilised for the respective components, the different granulating agents being selected for differing lyophilic and hydrophilic properties such as to impart to the components different times of dissolution in the earth in stages embracing the required predetermined extended period of activity, each component being prepared by mixing the pulverulent fertiliser with the respective granulating agent, heating the mixture to melt the granulating agent while vigorously stirring the mixture, and then cooling the resultant hot mix to room temperature while under reduced stirring to form granules consisting of particles of the fertiliser coated and bound with the granulating agent; and mixing the separately prepared components to form the composition.

6. A process as defined in claim 5 wherein a fatty alcohol polyglycol ether, alkylphenol polyglycol ether or a fatty acid alkylolamide is utilised as a granulating agent having pronounced hydrophilic properties.

7. A process as defined in claim 5 wherein glycerol monostearate, glycerol monoricinoleate, trimethylolpropyl monocaprinate, pentaerythrite monocaprylate, anhydrosorbite monolaurate or hexanol is utilised as a granulating agent having hydrophobic and hydrophilic properties approximately in balance.

8. A process as defined in claim 5 wherein pentaerythrite tristearate, glycerol distearate, glycerol tristearate, octyl alcohol, ricinoleic acid or 12-oxy-stearic acid is utilised as a granulating agent having predominantly hydrophobic properties.

9. A process as defined in claim 5 wherein spermaceti, stearyl stearate, stearyl alcohol, stearic acid, arachic acid, paraffin wax, synthetic paraffin wax or a mixture of either with mineral oil, stearic acid amide or distearyl ether is utilised as a granulating agent having pronounced hydrophobic properties.

10. A process as defined in any one of claims 5 to 9 wherein the pulverulent fertiliser employed is urea.

11. A process as defined in any one of claims 5 to 9 wherein the pulverulent fertiliser employed is calcium cyanamide.

12. A process for the production of a granular fertiliser composition capable of developing fertilising activity over an extended

period of time substantially as described in the foregoing Example.

13. A granular fertiliser composition prepared by a process as defined in any one of claims 5 to 12.

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